INTERPRETATIONS OF THE IMAGINAL AND LARVAL CHARACTERS, INCLUDING DISTINCTIONS AMONG MELANDRYIDAE, MYCETOPHAGIDAE, AND TETRATOMIDAE (COLEOPTERA)

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Abstract

After considering the similarities and differences in imaginal and larval characters of the 3 families, they appear to be phylogenetically related and to have evolved in the following phylogenetic sequence: 1. Tetratomidae. 2. Mycetophagidae. 3. Melandryidae.

Introduction

The heteromerous beetle families Melandryidae Leach (1815) [including Serropalpidae Latreille (1825) but excluding Synchroidae Horn (1883)], Mycetophagidae Leach (1815), and Tetratomidae Mulsant (1856) are badly in need of systematic revision for the world. There are presently only preliminary and isolated studies by Crowson (1955, 1964 and 1966), Hayashi (1971 and 1972) on Japanese larvae, Miyatake (1960) on Japanese Tetratomidae, Viedma (1966 and 1971) on Melandryid larvae, Arnett (1971) on American fauna, and Abdullah (1964) on Baltic amber Heteromera. These 3 families are reviewed here because they seem to be close phylogenetically and have *heteromeroid aedeagi*. It follows that any modern classification that splits them in such different groups as Clavicornia and Heteromera, as was the old practice, is artificial.

Crowson (1966:512) considered the existing family Tetratomidae as resembling the common ancestor of Heteromera, while regarded Diphyllidae LeConte (1861) [=Biphyllidae Sharp (1900)] and Byturidae Thomson (1859) as clavicorn ancestors of Heteromera (Crowson 1967). My view is quite different on this subject (Abdullah 1973a and Abdullah & Abdullah, 1966). I regard Diphyllidae and Byturidae as Heteromera (and not Clavicornia), and as the 2 most primitive families of Heteromera (more than Tetratomidae).

Observations on the similarities and differences among the adults and larvae of these 3 families are presented below.

Similarities in the adult stage

1. The modes of life, *habits*, and foods are rather similar. Melandryids are found under bark, Mycetophagids are fungivorous under bark, and also feed on pine pollen. Tetratomids are also fungivorous.

2. Melandryids are elongate, convex, and slender to somewhat broadened

in *shape*. Mycetophagids are obovate, broad, and depressed. Tetratomids are elongate, convex, slender to somewhat broadened, or broadly oval and rather flattened.

3. *Size* or length in mm: Melandryids, 3-20; Mycetophagids, 1.5-6; and Tetratomids, 3-20.

4. *Coloration*. Melandryids: castaneous, brown or dark, rarely with yellow markings. Mycetophagids: brown to piceous, sometimes with orange or reddish markings. Tetratomids: dark.

5. *Vestiture*. Melandryids: sparse to moderately dense but short and subdepressed. Mycetophagids: short, moderate, sparse to dense, sub-erect hairs. Tetratomids: usually sparse.

6. *Punctation and head surface*. Melandryids: smooth, punctate or rugose. Mycetophagids: punctate or rugose-punctate. Tetratomids: smooth, punctate.

7. *Head shape*. Melandryids: deflexed, posteriorly constricted or not. Mycetophagids: short, triangular, slightly deflexed. Tetratomids: ? as in Melandryidae.

8. *Type of antenna*. Melandryids: filiform or somewhat thickened or serrate. Mycetophagids: clavate; segments 7-11 enlarged, or with a 2- to 3-segmented club. Tetratomids: clubbed or thickened apically.

9. *Number of segments in antenna*. Melandryids: 11, rarely 10. Mycetophagids: 11. Tetratomids: 11.

10. Antennae *not inserted* under lateral expansions or ridges of frons in all 3.

11. *Apex of mandible*. Melandryids: simple or bifid, acute or blunt. Mycetophagids: blunt, curved. Tetratomids: ? as in Melandryidae.

12. *Apical segment of maxillary palp*. Melandryids: often long and more or less enlarged. Mycetophagids: simple to enlarged. Tetratomids: dilated.

13. *Apical segment of labial palp*. Melandryids: dilated, elongate. Mycetophagids: simple, slender. Tetratomids: ? dilated.

14. *Eyes* are both entire and emarginate in Melandryidae and Mycetophagidae; Tetratomids emarginate.

15. The *neck is wide* in all 3.

16. *Pro-coxal cavities are externally or visibly open* in all 3.

17. Pro-coxal cavities are *internally open* in Mycetophagidae, but both open and internally *closed* condition exists in Melandryidae and Tetratomidae.

18. *Pro-coxae are without substantial concealed lateral expansions* in all 3.

19. Pro-coxae are *not separated* by a flat intercoxal process with lateral extensions behind coxae in all 3.

20. Pro-coxae are *externally not contiguous* in all 3.

21. Pro-coxae are *internally contiguous* in all 3.

22. Pro-thorax is *not Bostrichoid* or Cisid-like in all 3.

23. Pro-thorax has *distinct side borders* in all 3.

24. Pronotum is *not apically flanged* in any.

25. There are *no antenna-receiving grooves on pro-pleura* in all 3.

26. *Trochantins of meso-coxae are exposed* in all 3.

27. *Meso-coxal cavities are open* by reaching of mes-epimera (and not closed by meeting of sterna) in all 3.

28. Meso-coxae are completely *separated* by intercoxal processes of sterna in all 3.

29. *Penultimate segments of tarsi are simple* in all 3 (exceptionally front tarsus may be lobed or pulvilliform in some Melandryids).

30. *Ante-penultimate segments of tarsi are simple* in all 3.

31. *Tarsal claws are simple* in all 3 (except in Osphyinae of Melandryidae where they are strongly toothed or split, a derivative feature!).

32. *All trochanters are heteromeroid* in all 3.

33. *Legs without ctinidia* in all 3 (although, rarely tibiae with numerous transverse ridges bearing spinules are found in Melandryidae).

34. *Blytra are without vein-like ribbings* in all 3.

35. *Apices of elytra are simple and similar in both sexes* in all 3.

36. Blytra are *without distinct pseudopleura* or epipleural fold in all 3.

37. *Metasternum is not spinous* (in the male) in all 3.

38. *Meta-coxae are contiguous* or nearly so in all 3.

39. *Wings have radial cells* in almost all of them.

40. *Anal cells* are present in the wings of Mycetophagidae and Tetratomidae (? but perhaps not in Melandryidae).

41. The *apparent number of anal veins* is 5 in all 3.

42. *Type of furca or met-endosternite.* Melandryidae: Hylecoetoid. Mycetophagidae: Hylecoetoid (? to not so). Tetratomidae: Hylecoctoid (approaching Boridae).

43. *Met-endosternite with long arms* in all 3.

44. *Met-endosternite with the anterior tendons far apart* in all 3.

45. Met-endosternite with the *anterior tendons* arising on the arms in Tetratomidae, but both from the arms or from the body of furca in Melandryidae and Mycetophagidae.

46. Met-endosternite without an *anterior median projection* in front of arms in Mycetophagidae and Tetratomidae, but with or without one in Melandryidae.

47. *Number of visible abdominal sternites* (or sterna) 5 in all 3.

48. *No connate visible abdominal sternites* in all 3.

49. *Orientation of tegmen and median lobe.* Melandryidae: inverted heteromeroid (rarely normal heteromeroid). Mycetophagidae: both conditions. Tetratomidae: inverted heteromeroid, tegmen ventral and median lobe or penis dorsal.

50. *Ovipositor long and tubular* in all 3.

51. Ovipositor with the *coxite 2-segmented* in Melandryidae (Not known in Mycetophagidae and Tetratomidae but expected to be similar).

52. *Abdominal appendages absent* in all 3.

53. *Last abdominal tergite* not produced into a Mordellid-like posteriorly directed *spine* in all 3.

Differences in the adult stage

1. *Eyes* are described to be large and lateral in Mycetophagidae, small in Melandryidae, and variable in Tetratomidae.

2. *Pro-coxae* or front coxae are transverse and *non-projecting* in Mycetophagidae and Tetratomidae, but in Melandryidae they are distinctly *projecting.*

3. *Trochantins of pro-coxae* are *exposed* in Mycetophagidae and Tetratomidae but *not* in Melandryidae.

4. *Mes-episterna* are reported meeting in front of mesosternum in Mycetophagidae but not in Tetratomidae, while both conditions are found in Melandryidae.

5. *Tarsal formula.* Melandryidae: 5-5-4. Mycetophagidae: 4-4-4 or 3-4-4 in male. Tetratomidae: 5-5-4.

6. *Tibial spurs* are *simple* in Mycetophagidae and Tetratomidae but *serrate* in Melandryidae.

7. *Internal keel of meta-coxa* is reduced to a narrow-based apophysis in Mycetophagidae and Tetratomidae. This is also the case in some Melandryidae but in others the keel is long and simple.

8. *Hind-wing has a sub-cubital fleck* in Melandryidae and Mycetophagidae. The fleck may be present or absent in Tetratomidae (? and is perhaps absent in a few Melandryids also).

9. *Mes-endosternite with the arms distinctly branched* are found in some Melandryids. The arms are, however, not branched in Mycetophagidae, Tetratomidae and some Melandryidae.

10. *Met-endosternite with laminae* are found in Mycetophagidae, Tetratomidae and some Melandryidae. Laminae are, however, absent in other Melandryidae.

11. *Tegmen with the parameres* or lateral lobes or gonostyli separate at apex in Mycetophagidae and Tetratomidae but fused apically in Melandryidae.

12. *Median lobe with 1 median strut* in Melandryidae and Tetratomidae but 2 in Mycetophagidae.

Note: It may be possible to use imaginal character number 19 under similarities (*vide supra*) to partially separate some Mycetophagids. Some *exceptions* are expected to be discovered in both the imaginal and larval characters described here, as the 3 families are revised for the world.

Similarities in the larval stage

1. *Habits.* Melandryidae: under bark and within fungi. Mycetophagidae: in fungi, cones of *Pinus*, and in dried flowers of *Opuntia*, etc. Tetratomidae: in fungi.

2. *Shape.* Orthosomatic, rather fusiform in *Penthe* (Tetratomidae).

3. *Body length in mm.* Melandryidae: 3-30. Mycetophagidae: 3-8. Tetratomidae: 4-12.

4. *Coloration* and *vestiture* rather similar in all 3.

5. *Hypostomal margins or rods.* Melandryidae and Tetratomidae: present or absent. Mycetophagidae: present.

6. *Hypopharyngeal sclerome.* Melandryidae and Tetratomidae: present or absent. Mycetophagidae: present.

7. *Number of antennal segments* 3 in all 3.

8. *Mandibles* both *symmetrical* and *asymmetrical* in Melandryidae and Tetratomidae but only asymmetrical in Mycetophagidae.

9. *Mandibular mola* both present and absent in Melandryidae and Tetratomidae, but not absent in any known Mycetophagid.

10. Mola without fine *transverse ridges* in all 3.

11. *Fleshy or setose post-molar appendage and penicillus* absent in all (? except possibly some *Penthe*—Tetratomidae, and *Eustrophinus*—Melandryidae).

12. *Retinaculum* both present and absent in all 3.

13. *Maxillary cardo* not divided and bi-partite in Tetratomidae, but both divided and entire or undivided cardo are found in Melandryidae and Mycetophagidae.

14. *Maxillary mala not toothed* in all 3.

15. Mala with or without *uncus* (non-dentate, spine or hook-like process) in Melandryidae and Tetratomidae, but absent in all Mycetophagids.

16. *Ligula* present in all 3.

17. *Gula not distinct from submentum,* the 2 being united or fused in all 3 (? distinct in some *Penthe*).

18. Number of *leg segments* and claws normal in all 3.

19. *Prothorax* not appreciably wider than other thoracic segments in all 3.

20. *Abdominal segments* 10 in all 3 (? may be 9 in some Mycetophagidae).

21. *Ninth abdominal sternite without asperities* in all 3.

22. Ninth sternite not composed of *a series of small plates* in any.

23. Ninth sternite not *broad, flat, plate-like* in shape in all 3.

24. *Urogomphi* present in Tetratomidae, but both present and absent in Melandryidae and Mycetophagidae.

25. *Urogomphi simple* and un-branched in Melandryidae and Mycetophagidae, but in some Tetratomidae urogomphi may be slightly complex.

26. Urogomphi both widely and narrowly *separated at base* in all 3.

27. *Tenth sternite* produced or not produced into 1 or 2 *pseudopods* in Melandryidae and Tetratomidae, but never distinctly produced in Mycetophagidae.

28. *Spiracles not cribriform* in any of them.

29. Spiracles not provided with a *series of small peripheral tubes* in any known species in all 3.

Differences in the larval stage

1. *Coronal suture.* Melandryidae: present or absent. Mycetophagidae: present. Tetratomidae: present.

2. *Frontal suture.* Melandryidae: lyriform or V-shaped. Mycetophagidae and Tetratomidae: lyriform.

3. *Clypeal or epistomal or frontoclypeal suture.* Melandryidae: present or absent. Mycetophagidae and Tetratomidae: absent.

4. *Number of ocelli.* Melandryidae: 6-10. Mycetophagidae: 8-12. Tetratomidae: 10.

5. *Sensory appendix or sensorium or tactile papilla or accessory process of antenna.* Melandryidae: present or absent. Mycetophagidae and Tetratomidae: present.

6. *Third antennal segment* less than half longer than second in Melandryidae and Tetratomidae. In Mycetophagidae various (more or less).

7. *Antennal insertion separated from base of mandible by a visible strip* in Tetratomidae but *not* in Melandryidae and Mycetophagidae.

8. *Mandibular mola asperate* or with tubercles in Mycetophagidae, not asperate in Melandryidae, and both conditions exist in Tetratomidae.

9. *Armament of mola extending ventrally* in Mycetophagidae, not in Melandryidae, and both conditions exist in Tetratomidae.

10. At least 1 mandible with *multi-dentate* or multi-lobed *cutting edge along inner dorsal margin* in Tetratomidae but not in Melandryidae and Mycetophagidae.

11. *Prothorax* longer than meso- and meta-thorax in Melandryidae and Tetratomidae, but both longer and shorter in Mycetophagidae.

12. *Spiracles annular-biforous* in Melandryidae and Tetratomidae. In Mycetophagidae, however, they are variable: with or without an extentional part on margin, annular, circular, guitar-shaped or annular-biforous.

Phylogeny of Melandryidae

According to Crowson (1966) and Viedma (1971) of the 3 subfamilies (Eustrophinae, Melandryinae, and Osphyinae) of Melandryidae, the most primitive is Eustrophinae, and both regard this subfamily as annectant to primitive Tetratomidae [Pisenini: *Pisenus* including *Pseudotriphyllus*, and *Eupisenus* doubtfully including *Integrinus, sensu* Miyatake (1960)].

In searching for the true relationships of Melandryidae, it would be necessary to revise the adults and larvae of world Eustrophinae (primitive subfamily) as well as those of world Pisenini (primitive group of Tetratomidae). The few known characters indicate that the Melandryidae have most probably evolved from Tetratomidae. Future systematic revisions are expected to support this view, as well as to prove or disprove the rather ambiguous suggestions of "affinities" to Scraptiidae, Mordellidae, and Rhipiphoridae in the literature. In all cases, the primitive groups need to be discovered and revised first.

Phylogeny of Mycetophagidae

A modern systematic revision of the family is much needed for the world, and particularly of the primitive groups to discover ancestry and phylogeny. My Baltic amber *Crowsonium* Abdullah (1964) should also be considered in this connection. From the published account of Mycetophagidae in Arnett (1971) it is possible to offer some suggestions. If *Myrmechixenis* is a Mycetophagid, then it would be better placed in a subfamily by itself, as suggested by the externally closed front coxal cavities, and this might prove to be a derivative group. The tarsal formula 5-5-5 in *Lendomus* (Lendomini) placed in Mycetophagidae in Arnett (1971) is thought provoking. It could be better placed elsewhere and may not be a Mycetophagid, or else should be a very primitive representative still possessing the ancestral clavicorn 5-5-5 tarsi. In the last event, other primitive characters are also expected to be present which will further strengthen the view. *Lendomus politus* Casey (1924) from Quebec should be first checked for the heteromeroid aedeagus in the male (to rule out the possibility of being a member of Clavicornia). Rather striking similarities of *Triphyllus*-group to Pisenini (Tetratomidae) have been interpreted as indicators of phylogenetic relationships between Mycetophagidae and Tetratomidae (*vide infra*).

Phylogeny of Tetratomidae

Miyatake (1960) classified the family into 3 tribes which could as well be considered natural subfamilies:

I. Pisenini (1. *Pisenus* including *Pseudotriphyllus*, 2. *Eupisenus*, doubtfully including *Integrinus*).

II. Tetratomini (3. *Tetratoma*, 4. *Abstrulia*, ? 5. *Incolia*).

III. Penthini (6. *Penthe*).

The most primitive tribe is Pisenini, and the most derivative is Penthini. Both Miyatake (1960) and Hayashi (1972) believe that Tetratomidae (particularly Pisenini) are phylogenetically related to Mycetophagidae (especially to the *Triphyllus*-group possibly including *Mycetophagus, Litargus*, and *Litargops*). If the *Triphyllus*-group represents the most primitive Mycetophagidae (which needs to be confirmed) then particular attention should be given to the systematic revision of adults and larvae for the world in order to discover the phylogeny of Tetratomidae and Mycetophagidae. The few characters given by Miyatake (1960) and Hayashi (1971 and 1972) could in fact be interpreted as indicators of true phylogenetic relationship between Tetratomidae and Mycetophagidae. They have not, however, clearly indicated the probable phylogenetic sequence which Crowson (1966:512) seems to suggest as Tetratomidae first (primitive) and Mycetophagidae as a direct offshoot (derivative). Future revisions are expected to throw more light on their phylogeny (*vide* Abdullah 1973a).

Acknowledgments

I wish to thank my fellow-coleopterists for sending reprints or photo-copies of their publications, particularly Drs. R. A. Crowson, N. Hayashi, M. Miyatake, and M. G. Viedma; and to my wife, Abida Abdullah, for her encouragement and assistance.

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LITERATURE NOTICES

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